Source apportionment of atmospheric aerosols using radiocarbon

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Radiocarbon (14C) is a powerful tool in atmospheric sciences for the distinction of emissions from modern sources and fossil-fuel usage, as the former shows the contemporary 14C level, whereas this radionuclide is extinct in the latter (Szidat, 2009). Due to this, the quantification of fossil and non-fossil sources is possible for carbonaceous aerosols, which is a substantial fraction of ambient particulate matter. This approach allows the apportionment of carbonaceous aerosols into main classes, such as emissions from traffic, biogenic emissions and biomass burning, serving as a basis for regulatory measures of air-quality improvement.

This presentation will highlight the potential and the requirements of this method based on different campaigns. In a long-term study in Switzerland, the contribution of wood burning to high concentrations of carbonaceous aerosols in winter was distinguished from traffic emissions and quantified (Zotter et al., 2014). This study also showed that the physical separation of organic carbon (OC) and elemental carbon (EC), two sub-fractions of the carbonaceous aerosols (Zhang et al., 2012), is a prerequisite for 14C source apportionment. Radiocarbon results from episodes of extreme haze events in East Asia revealed the relevance of so-called secondary aerosols, i.e. particulate matter that has been formed in the atmosphere by chemical transformation of gaseous precursors (Zhang et al., 2015; Zhang et al., 2016). Here, 14C analysis even enables a unique apportionment of the secondary organic aerosols into fossil vs. non-fossil precursors, as the isotopic trace survives the chemical transformation.

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